
Space Weather Technical Forecast

Issued on Wednesday, 13 July 2022 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: R1-R2 blackouts likely, slight chance of R3 blackouts. G1/Minor Storms likely, slight chance of G2/Moderate Storms Day 1 (13 July). Slight chance of S1 throughout, with slight chance of Active fluence later in period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with only C-class flares in the last 24 hours. The largest and also most recent one was a C7 observed at 12/1354 UT from AR3057. There are five sunspot regions on the visible disc. AR3055 remains the largest and most complex region magnetically speaking however, it is mostly inactive. AR3056 in the SE remains in a delta configuration, with a complex and strong leading group but it is not as active as it once was. AR3053 and AR3057 are both showing signs of development, with proliferation of spots. AR3052 remains unchanged, now a simple unipolar group.

There are numerous large filaments on the Sun, some of which spanning roughly 20 degrees on the solar disc. There were no signs of instability in these in the reporting period, however they will need to be monitored for nay lift-off, particularly as some of them are now transiting across the western hemisphere. Earth-directed CMEs were observed in available imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, became enhanced in the last 24 hours, most likely under the influence of the high speed stream originating from Ch99/+. The solar wind speed was at slow-ambient levels and mostly around 330 km/s initially but started to increase from 12/0530 UTC, reaching 530 km/s by the end of the period. The density was slightly above average initially, peaking 17 ppcc around 12/0300 UTC, then became largely average over time. The IMF was moderate, peaking 18nT at 12/0741 UTC, but also became mostly weak over time. The north-south component showed important fluctuations between 12/0500-1200 UTC, varying between -14 and +13nT, but much weaker outside of this period. The phi angle was largely positive (away from the Sun). The resultant geomagnetic activity was mostly Unsettled to Active with a G1 / Minor Storm interval between 12/1200-1500 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, is at background levels.

The high energy electron flux (greater than 2 MeV) remained at background levels. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold on a roughly level trend. Observed fluence was 2.09e6 integrated pfu at 13/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with a slight chance of X-class flares.

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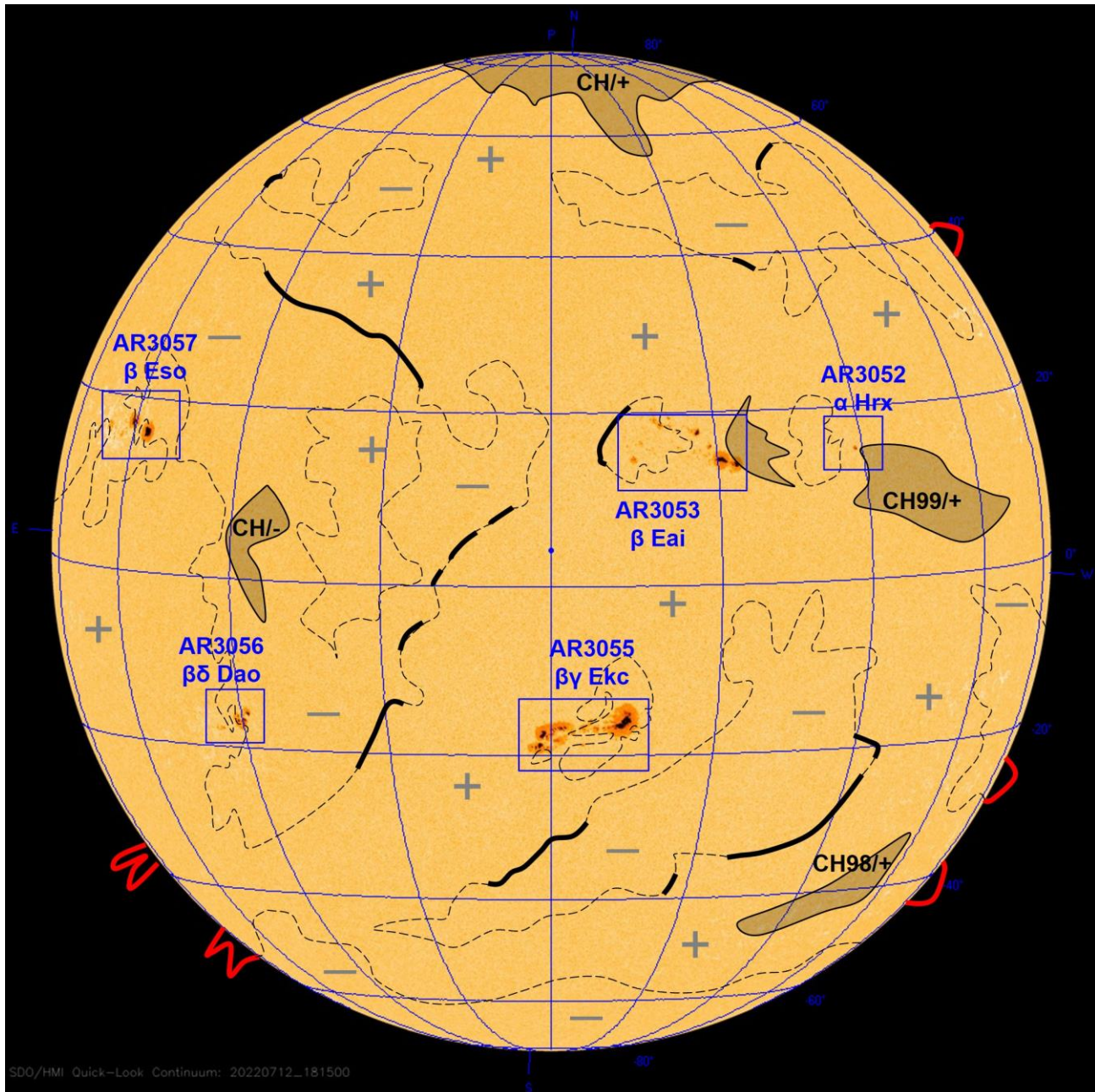
Solar Wind / Geomagnetic Activity: The solar wind is expected to be mostly elevated on days 1 and 2, under the influence of the HSS originating from CH99/+. However it may be superseded by the arrival of a CME that left the sun on 09 July, perhaps increasing the solar wind to strong levels. This CME is expected to arrive early on day 1 (13th), with confidence and effects decreasing rapidly over time. Otherwise, solar winds are expected to ease on days 3 and 4.

Overall geomagnetic activity is expected to be Unsettled to Active, with a Chance of G1/Minor Storms and a slight chance of G2/Moderate Storms under CME effects. Geomagnetic activity then returning to mostly Quiet levels on days 2-4 (14-15-16 July).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels. There is however a daily Slight Chance of S1 or greater, due to the presence of two relatively large sunspot regions transiting across the western hemisphere.

The high energy electron flux (greater than 2MeV) may become high later in the period, the chance increasing over time. The corresponding electron fluence is expected to display a sharp rising trend from day 2 onwards, perhaps exceeding the Active threshold (1e8 integrated pfu) on day 4 (16 July).

Figure 1. Solar Analysis Valid 12/2000 UTC.



Key: Filament —, Prominence —, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

Earth may receive a glancing blow from a CME that left the Sun on the 09 July. While the bulk of the ejecta is expected to miss behind Earth's orbit, a glancing blow is considered likely and its arrival is estimated to be early on Day 1 (13 July).

The solar wind is currently at elevated levels and is expected to remain enhanced on day 1 and day 2, under the influence of the high speed stream originating from CH99/+ and perhaps some minor contribution from CH98/+. CH99 is a recurring feature that generated speeds of 600 km/s on the previous rotation. However, due to its smaller size and fragmentation in the intervening month, it is hard to envisage similar speeds will be achieved this time around.

That said, any increase in the HSS may be superseded by the expected arrival of the CME, perhaps increasing the solar wind to strong levels. Otherwise, solar winds are expected to ease on days 3 and 4.

Overall geomagnetic activity is expected to be Unsettled to Active, with a Chance of G1/Minor Storms and a slight chance of G2/Moderate Storms under CME effects. Geomagnetic activity then returning to mostly Quiet levels on Days 2 -4 (14-15-16 July), with the odd Unsettled interval at times.

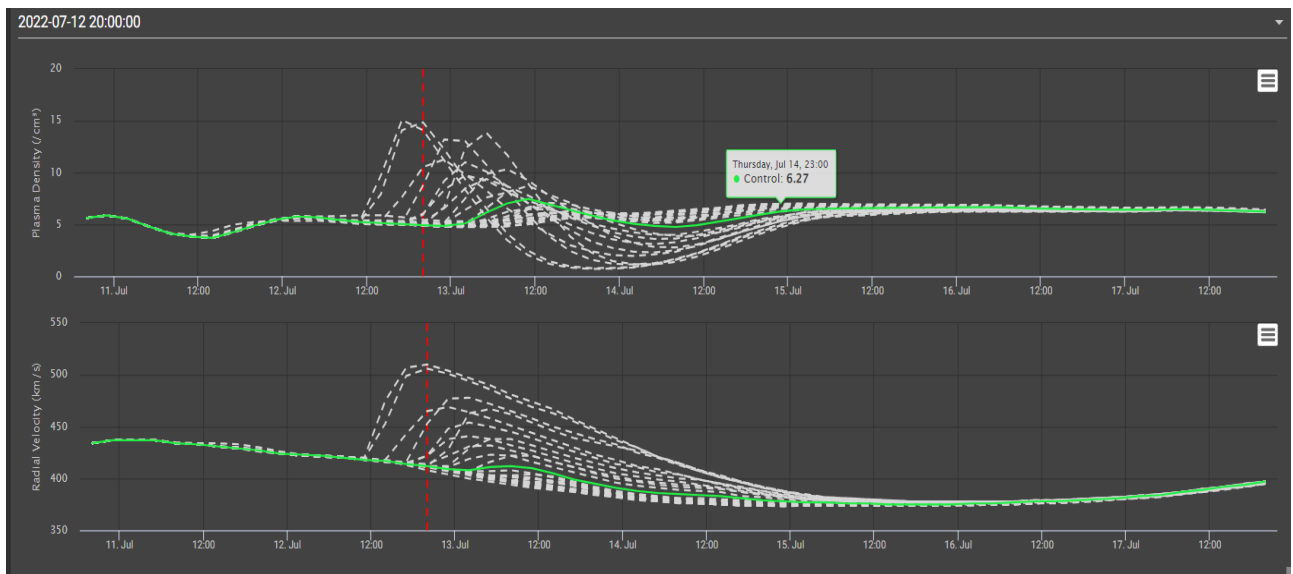
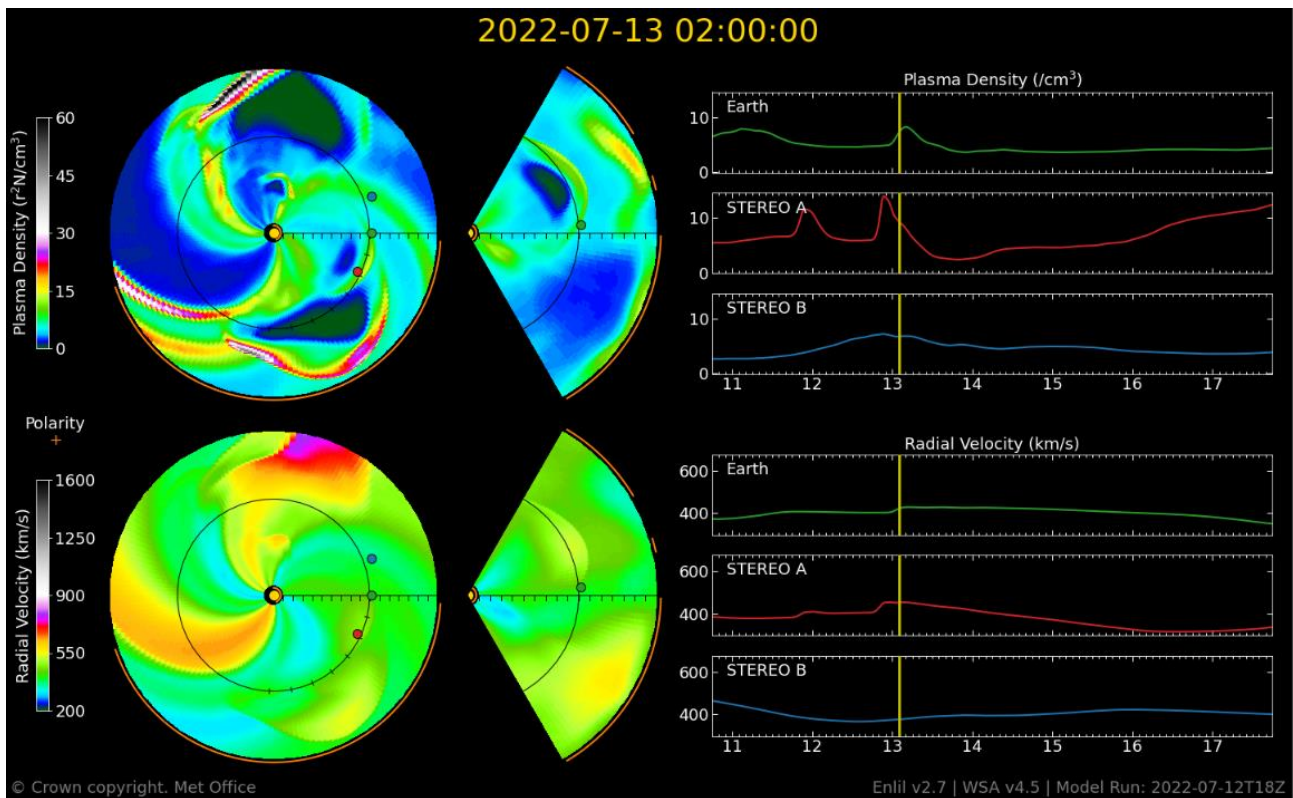
Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	50	1	1	1
Strong	G3	No	2	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
10/0500	Partial	AR3052	NE quadrant	918 km/s	12/2200 UTC +/- 6 hrs	Moderate shock

Figure 2: Enlil model and ensemble, showing a possible CME arrival early Day 1 (13 July)

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Radio Blackouts - X-Ray Flares:

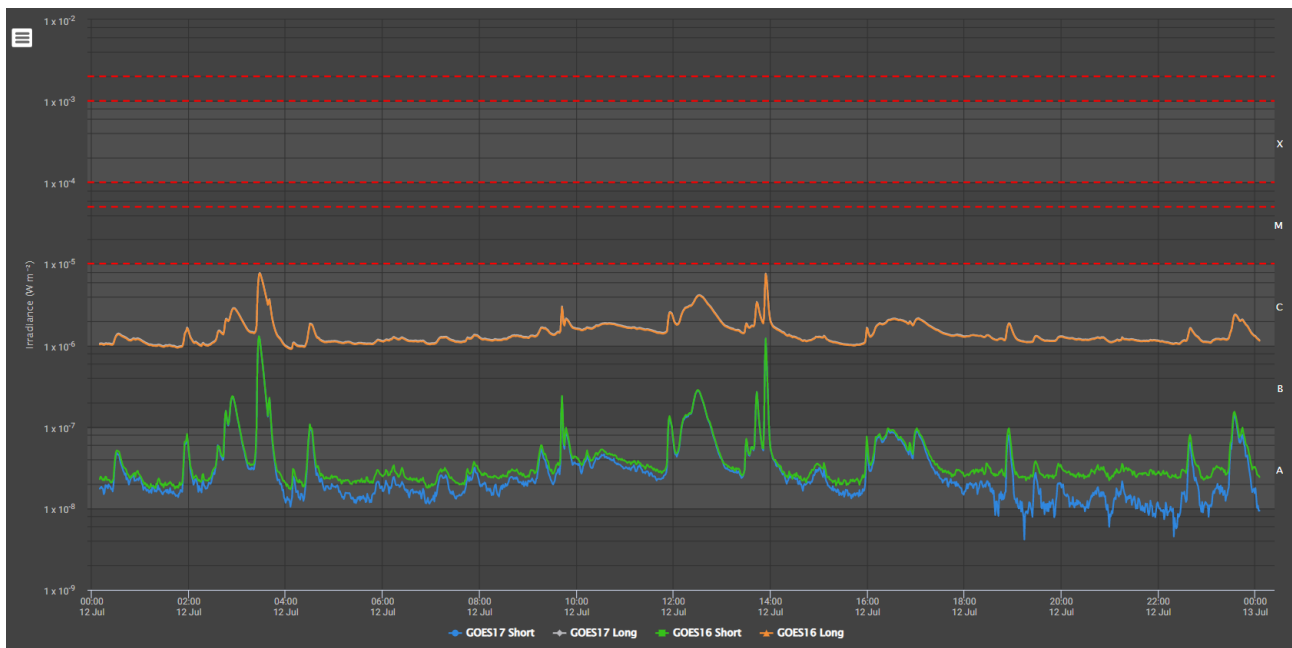
Solar activity has been Low in the last 24 hours, with only C-class flares observed. Background x-ray flux is now in the C-class category however.

There are now five sunspot regions on the visible disc, AR3051 having vanished all at once. AR3055 remains the largest and most complex region magnetically speaking however, it is mostly inactive and its trailing group is now somewhat declining. AR3056 in the SE remains in a delta configuration, with a complex and strong leading group but some weak trailing spots that keep fading and reappearing. This region is not as active as it once was. AR3057 in the NE is developing slowly, with proliferation of spots. AR3053 is showing signs of development with proliferation of spots on its trailing group but at the same time, saw its leading spot split in two entities requiring a change of classification. AR3052 remains unchanged, now a simple unipolar group.

Solar activity is expected to be Low to Moderate, with a slight chance of X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 3: Latest X-ray flare activity, as seen by GOES. Low activity observed.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is now back to background levels, after it became slightly elevated on the 09 July (in response to a C8 flare). There is a slight chance of S1 or greater, due to the presence of two relatively large sunspot regions transiting across the western hemisphere.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	15	15	15	15
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) is currently at background levels. CH99 is currently bringing an increase in wind speeds which may cause some electron charging, however the anticipated CME arrival early on day 1 (13 July) is likely to cause a temporary suppression in electron levels.

The risk of the electron flux becoming moderate or high then increases dramatically over time as the magnetic cloud draws to an end, allowing the Van Allen belts to recharge themselves. However confidence is low as the rise is rarely immediate and can take a few days to become effective. The corresponding electron fluence is expected to rise later in the period, perhaps exceeding the Active threshold ($1\text{e}8$ integrated pfu) on day 4 (16 July).

The latest REFM is considered to provide good guidance with regards to the trend, however it is based on the electron flux observed over the past rotation and as such, will not have taken the anticipated CME into account. The rise is therefore expected to be delayed by at least 24 hours.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	10	30	50
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: Latest REFM output – while the trend is considered to provide good guidance, the rise (white dots) is expected to be delayed by 24 hours at least.

